7 300-FF

7.1 Overview

The 300-FF groundwater interest area is located in the southeastern Hanford Site. It includes the 300-FF-5 OU, where groundwater was contaminated by releases at the 300 Area Industrial Complex, the 618-10 Burial Ground/316-4 Crib, and the 618-11 Burial Ground (Figure 7-1). Table 7-1 summarizes key facts about 300-FF. Section 1.3 provides details about plume mapping, including descriptions of terms in figure legends (e.g., Type 1 Control Point).

300-FF groundwater contamination originated primarily from historical routine disposal of liquid effluent associated with fabrication of nuclear fuel assemblies and research involving the processing of irradiated fuel. Because principal liquid waste disposal facilities have been out of service for decades and most have been remediated by removing contaminated soil (Section 4.0 of DOE/RL-2004-74), the contamination remaining in the underlying vadose zone and aquifer is residual.

The groundwater in 300-FF is monitored under CERCLA, the AEA, and RCRA (DOE/RL-95-73; WHC-SD-EN-AP-185). The CERCLA contaminants in the groundwater are uranium, gross alpha, TCE, *cis*-1,2-dichloroethene (DCE), tritium, and nitrate. The former 300 Area Process Trenches (316-5) are an inactive TSD regulated under RCRA and undergoing post-closure monitoring.

Groundwater in the unconfined aquifer beneath the southeastern portion of the Hanford Site flows east or southeast toward the Columbia River (Figure 7-1). This flow direction is induced by regional groundwater flow that converges from the northwest, west, and southwest. Flow patterns throughout the region are complicated by the variable permeability of sediment in the upper portion of the unconfined aquifer. Near the Columbia River, groundwater flow is also influenced by river stage fluctuations. In 2014, groundwater underlying the 300 Area Industrial Complex flowed southward during low river stage (based on measurements made in March) and southwest during high river stage (based on measurements made in June).

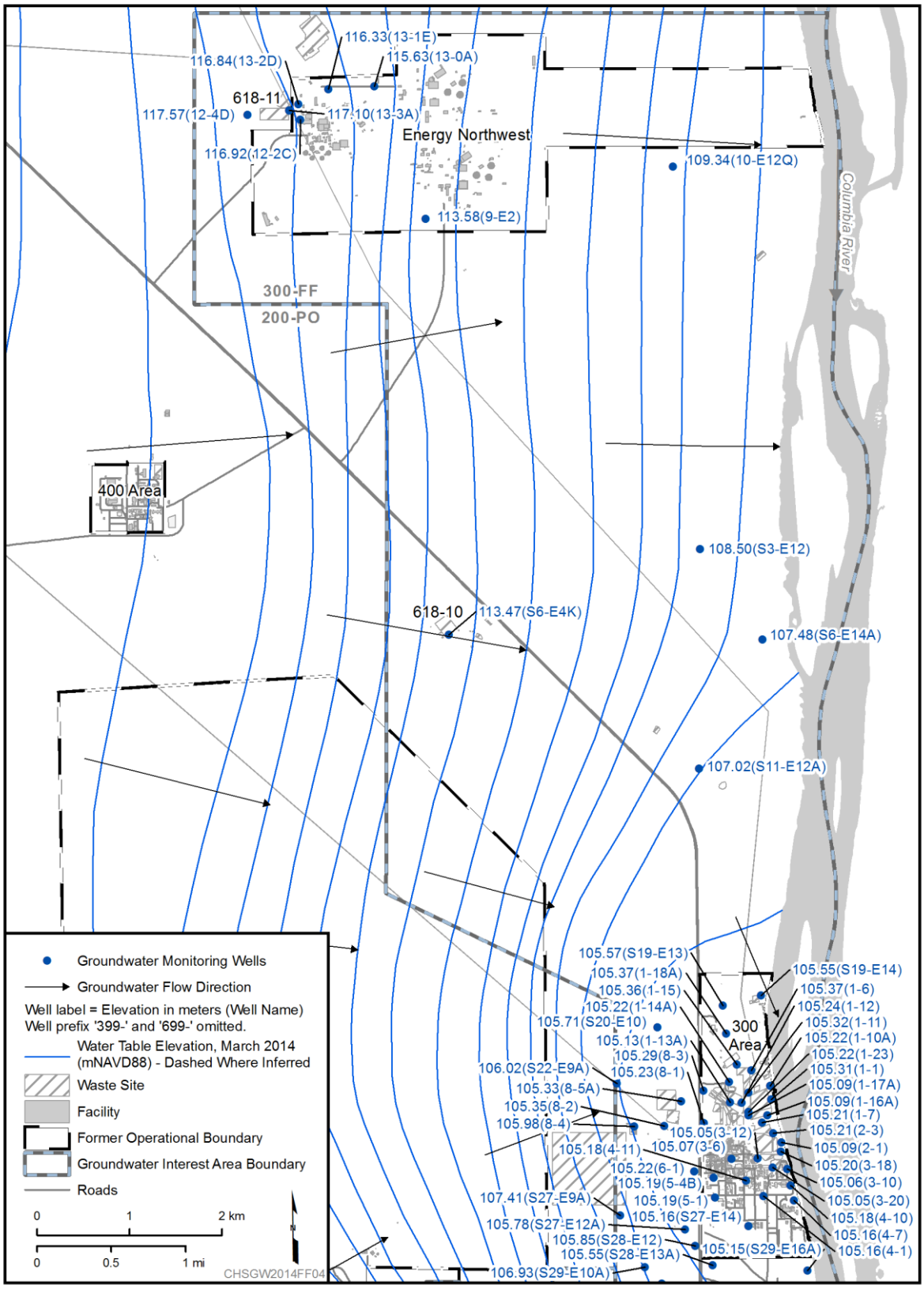

Figure 7-1. 300-FF Overview Map with Groundwater Flow

Table 7-1. 300-FF at a Glance

Fabrication of nuclear fuel assemblies: 1943–1987

Research in irradiated fuel processing: 1950s–1960s

300-FF includes 300 Area Industrial Complex, 618-10 Burial Ground/316-4 Crib, and 618-11 Burial Ground

2014 Groundwater Monitoring

Contaminant	Cleanup Level[a]	Maximum Concentration	Plume Area[b] (km^2)	Shoreline Impact (m)
Uranium (300 Area Industrial Complex)	30 µg/L	358 µg/L (399-1-62)	0.37	1,150
cis-1,2-Dichloroethene (DCE) (300 Area Industrial Complex)	16 µg/L	207 µg/L (399-1-16B)	Undefined[c]	Undefined[c]
Trichloroethene (TCE) (300 Area Industrial Complex)	4 µg/L	83 µg/L (AT-3-7-D)	Undefined[c]	Undefined[c]
Tritium (618-11)	20,000 pCi/L	994,000 pCi/L (699-13-3A)	0.12[e]	None[e]
Nitrate (618-11)	45 mg/L[d]	83.2 mg/L (699-12-2C)	0.19[e]	None

Remediation

Waste sites (interim action): In progress 2014; 91 percent complete[f].

Groundwater (interim action): MNA and ICs on the use of groundwater.

ROD for final remedial action issued in November 2013; implementation anticipated in 2015.

a. *Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site 300 Area* (EPA et al., 2013).

b. Estimated area at a concentration greater than the cleanup standard.

c. Organics are locally present in deeper sediments. Plumes cannot be defined by current data.

d. 45 mg/L nitrate ~ 10 mg/L NO_3-N; DWS.

e. Excludes tritium and nitrate in plume associated with 200-PO and nitrate from offsite.

f. Sites with status of closed, interim closed, no action, not accepted, or rejected.

COCs = contaminants of concern

ICs = institutional controls

MNA = monitored natural attenuation

ROD = Record of Decision

Contamination is generally found in the upper portion of the unconfined aquifer (i.e., the interval of Hanford formation gravelly sediment that lies below the water table) (Figure 7-2). The thickness of the contaminated portion of the unconfined aquifer is variable because of the undulating contact between the Hanford formation and the underlying Ringold Formation unit E. In addition, significant seasonal fluctuations in water table elevation (Section 3.0 of PNNL-17034) affect the thickness of the contaminated zone.

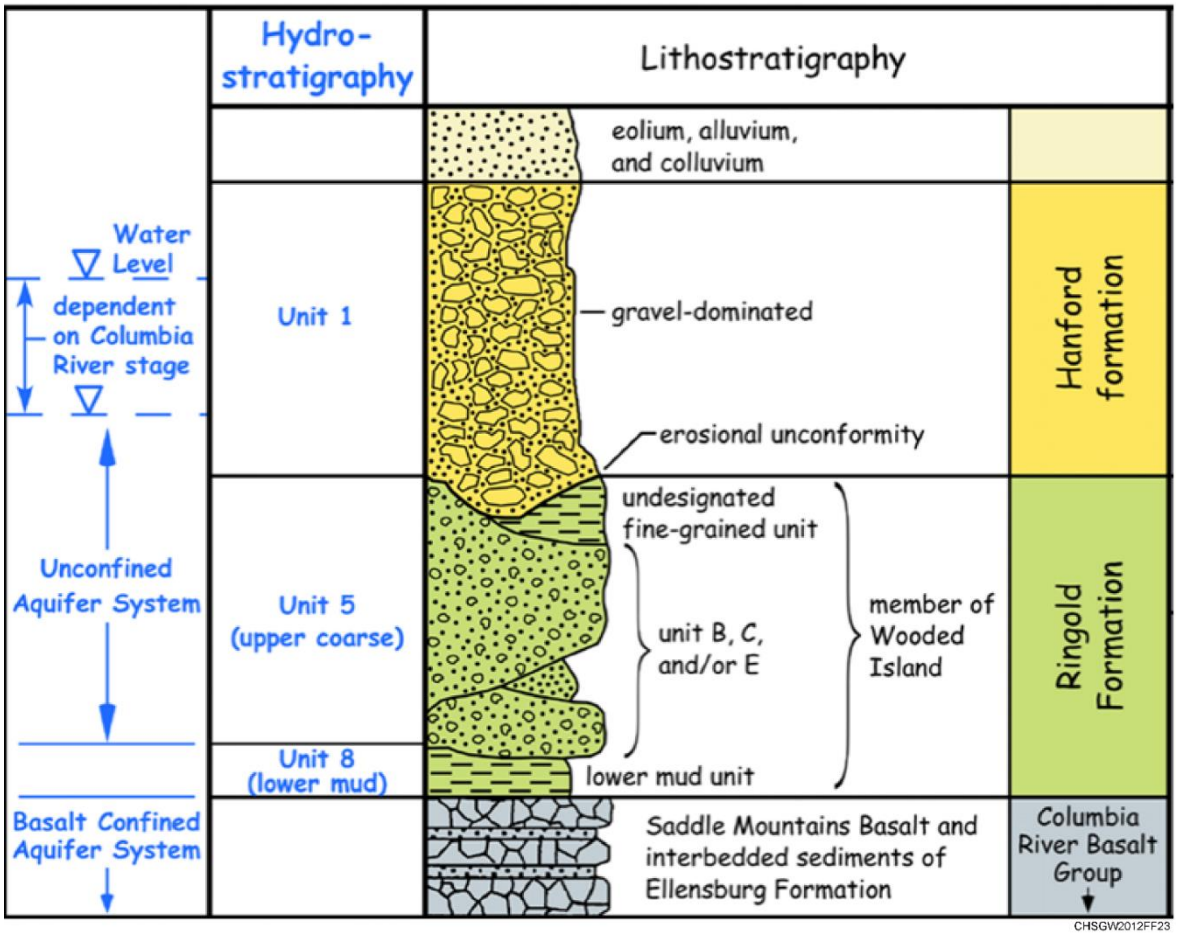

Figure 7-2. 300-FF Geology

Beneath the 300 Area Industrial Complex, paleochannels act as preferential pathways for groundwater flow (Figure 4-89 in DOE/RL-2010-99). In the 300 Area, contaminant discharge to the river occurs via riverbank springs that flow across the beach region (riparian zone) during periods of low river stage and by upward movement through the riverbed.

The rate of contaminant discharge to the river is influenced by daily and seasonal river stage fluctuations (Section 3.1 of PNNL-17708; Section 2.4.1 of PNNL-22048). The highest seasonal river elevations typically occur from May through June, and the lowest seasonal river elevations typically occur from September through mid-November (Section 4.4.2 of DOE/RL-2010-99). Effects of high river elevations include temporary reversal of flow direction, dilution of contamination in groundwater near the river by

the intrusion of clean river water, and possible influences on contaminant mobility caused by changes in the geochemical environment. Changes in the geochemical environment are most pronounced where river water intrudes into the aquifer. River water is lower in alkalinity (lower in bicarbonate content) and lower in specific conductance than groundwater (Section 3.6.1.4 of DOE/RL-2010-99).

Figure 7-3 illustrates how estimates of plume areas in the 300-FF groundwater interest area have changed since 2003.

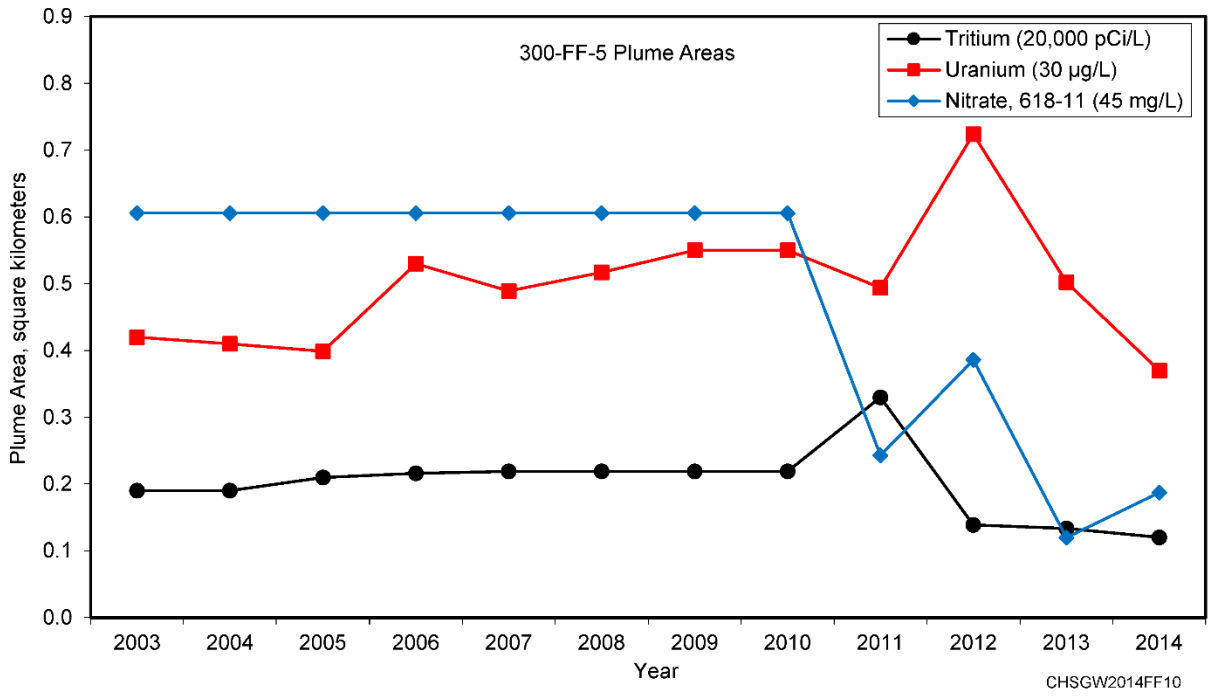

Figure 7-3. 300-FF-5 Plume Areas

7.2 CERCLA Activities

The RI/FS (DOE/RL-2010-99; DOE/RL-2010-99-ADD1) and the Proposed Plan (DOE/RL-2011-47) for the 300-FF-5 OU were issued in early July 2013, and the ROD (EPA et al., 2013) was signed by EPA and DOE on November 25, 2013. The COCs for groundwater are uranium, gross alpha, TCE, and DCE at the 300 Area Industrial Complex; and tritium and nitrate at the 618-11 Burial Ground.

The RAOs identified in the ROD for 300-FF-5 OU are as follows:

- Prevent human exposure to groundwater containing concentrations of COCs above cleanup levels.
- Prevent COCs migrating and/or leaching through soil that will result in groundwater concentrations above cleanup levels for protection of groundwater, and of surface water concentrations above cleanup levels for the protection of surface water at locations where groundwater discharges to surface water.
- Restore groundwater impacted by Hanford Site releases to cleanup levels which include DWSs, within a time frame that is reasonable given the particular circumstances of the site.

Cleanup actions for the 300-FF-5 OU will consist of four remedy components: (1) MNA for nitrate, tritium, TCE, and DCE; (2) groundwater monitoring for uranium, gross alpha, nitrate, tritium, TCE, and DCE; (3) enhanced attenuation of uranium using sequestration by phosphate application in the vadose zone and at the top of aquifer; and (4) ICs.

In accordance with the 2013 ROD, the in-progress interim action will use the cleanup levels in the ROD immediately upon issuance of the ROD. All other aspects of the interim action will continue to be performed in accordance with the existing documents for the interim action. The RDR/RA WP that implements the 2013 ROD is anticipated to be issued in 2015. When the new RDR/RA WP is approved, it will direct future remedial actions and will replace all interim action ROD work plan requirements.

The remedy selected for the 300-FF-5 OU in the 1996 interim action ROD (EPA/ROD/R10-96/134) was MNA and ICs. Groundwater monitoring required under the 1996 interim action ROD is implemented through a SAP (DOE/RL-2002-11, Rev. 2). Comprehensive sampling events occur semiannually. Most monitoring wells have screens positioned to monitor the upper portion of the unconfined aquifer. Several wells are screened in the lower portion of the unconfined aquifer and a few wells are screened in the uppermost confined aquifer.

Wells and aquifer tubes were sampled as planned during 2014, with the following exception. For one well and all of the aquifer tubes, the sampling scheduled for December 2014 was conducted in early January 2015 due to resource constraints. At two aquifer tubes, samples could not be collected because of no yield. Other minor exceptions to planned monitoring occurred because of maintenance issues and scheduling constraints. Appendix A lists the sampling frequencies, types of laboratory analyses, and sample status for 2014 for the 300-FF-5 OU monitoring wells. Appendix C lists the aquifer tubes. Figure 7-4 shows locations of wells and aquifer tubes sampled in 2014.

DOE's Office of Science, Biological, and Environmental Research, is supporting integrated laboratory and field research through the PNNL Scientific Focus Area to understand and model the multi-scale hydrobiogeochemical functioning of the groundwater-surface water interaction zone along the Hanford Reach of the Columbia River. The overall goal is to understand linked hydrologic, climatic, geochemical, and microbiologic processes that control contaminant and nutrient fluxes between groundwater and the Columbia River at scales ranging from local (50 to 500 m [164 to 1,640.4 ft]) to the reach (about 75 km [46.6 mi]). Recent studies have focused on seasonal water quality dynamics (including uranium and nitrate) driven by Columbia River stage changes using geophysical monitoring and high-density sampling and analysis of subsurface waters in an east-west transect from the Integrated Field Scale Research Challenge well field in the historic South Process Pond of the 300 Area, through a coarse-textured subsurface paleochannel and associated hyporheic zone, to discharge in the Columbia River. The Scientific Focus Area continues active publication in the peer reviewed literature as the primary mode of results dissemination with a new web-site (http://www.pnnl.gov/biology/sfa) containing a project description, key highlights, and all publications. Recent publications have addressed hydrologic exchange, microbiology, and reactive transport process of carbon, nitrate, and uranium in the hyporheic zone and near-shore aquifer of the 300 Area.

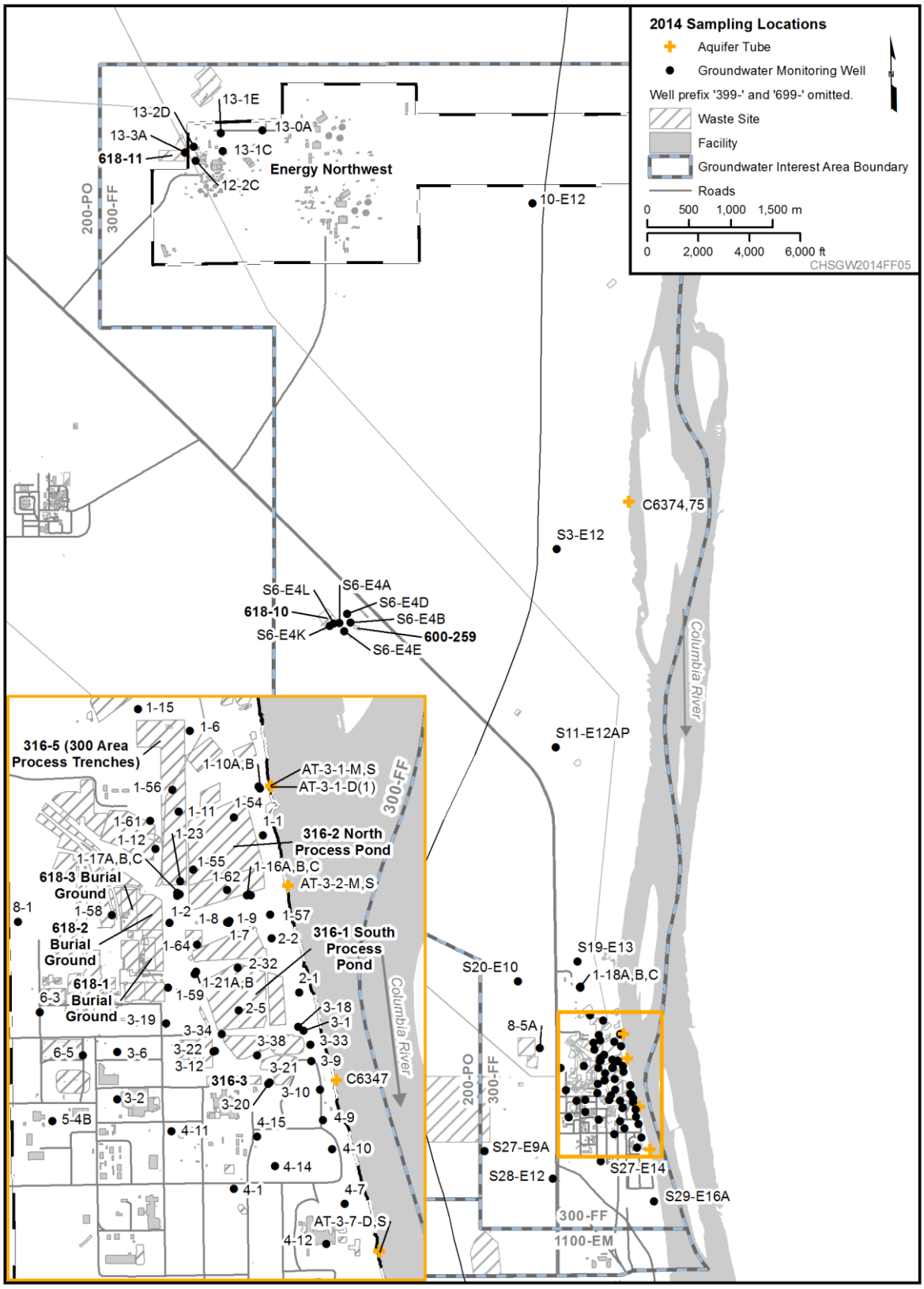

Figure 7-4. 300-FF Sample Locations, 2014

7.3 Uranium

Large volumes of liquid waste containing uranium were discharged to the former South Process Pond (316-1) (1943 to 1975), North Process Pond (316-2) (1948 to 1975), and 300 Area Process Trenches (316-5) (1975 to 1987). Discharge of cooling water with small quantities of nonhazardous maintenance and process waste continued at the 300 Area Process Trenches until December 1994 (Section 2.1 of PNNL-13645). Contaminated soil was removed from the 300 Area Process Trenches in 1991; additional excavation of contaminated soil occurred at this site and at other major liquid waste disposal sites in the 300 Area Industrial Complex from 1997 through 2000.

The areal extent of uranium contaminated groundwater that exceeds the cleanup level (30 µg/L, DWS) is estimated to be 0.4 km^2 (0.2 mi^2) beneath the 300 Area Industrial Complex. The persistence of the plume is attributed to resupply of mobile uranium from sources in the vadose zone and the periodically rewetted zone (the deepest part of the vadose zone through which the water table rises during high river stage) (Section 4.4.4.3 of DOE/RL-2010-99).

7.3.1 Uranium at Low River Stage

During seasonal low water table conditions, the highest uranium concentrations are often observed near the river, where uranium introduced inland during the preceding period of high water table conditions (due to groundwater contact with residual uranium in the lower vadose zone) has migrated downgradient to the shoreline, and intrusion of river water into the zone beneath the shoreline is lessened because of the lower river stage (Section 3.3 of PNNL-17034). The plume map (Figure 7-5) shows the uranium concentrations for the seasonal low water table conditions in December 2014. Figures 7-6 and 7-7 show the uranium concentration trends at locations representative of near-river conditions.

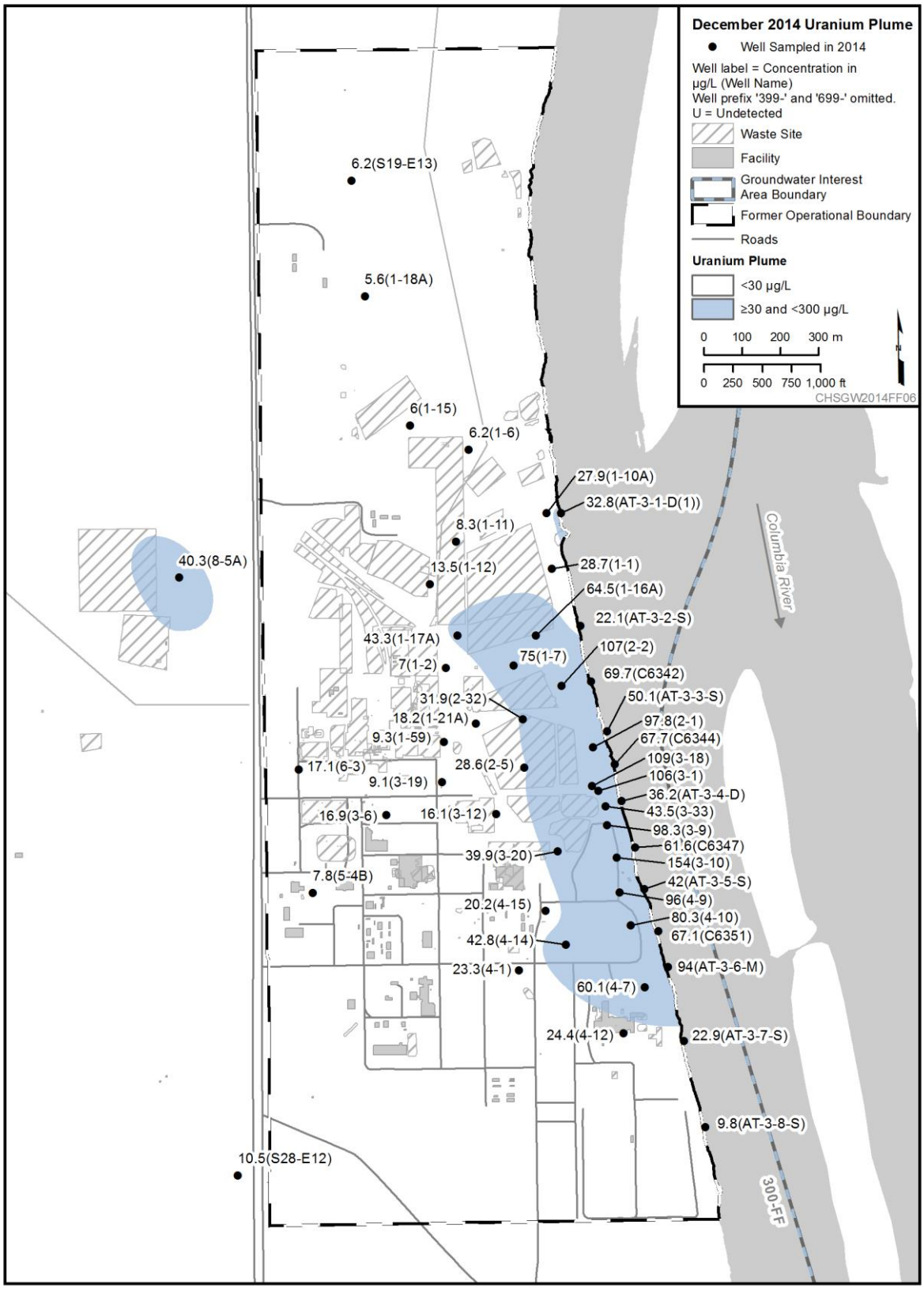

Figure 7-5. 300-FF 2012 Uranium Plume, December 2014 (Low River Stage)

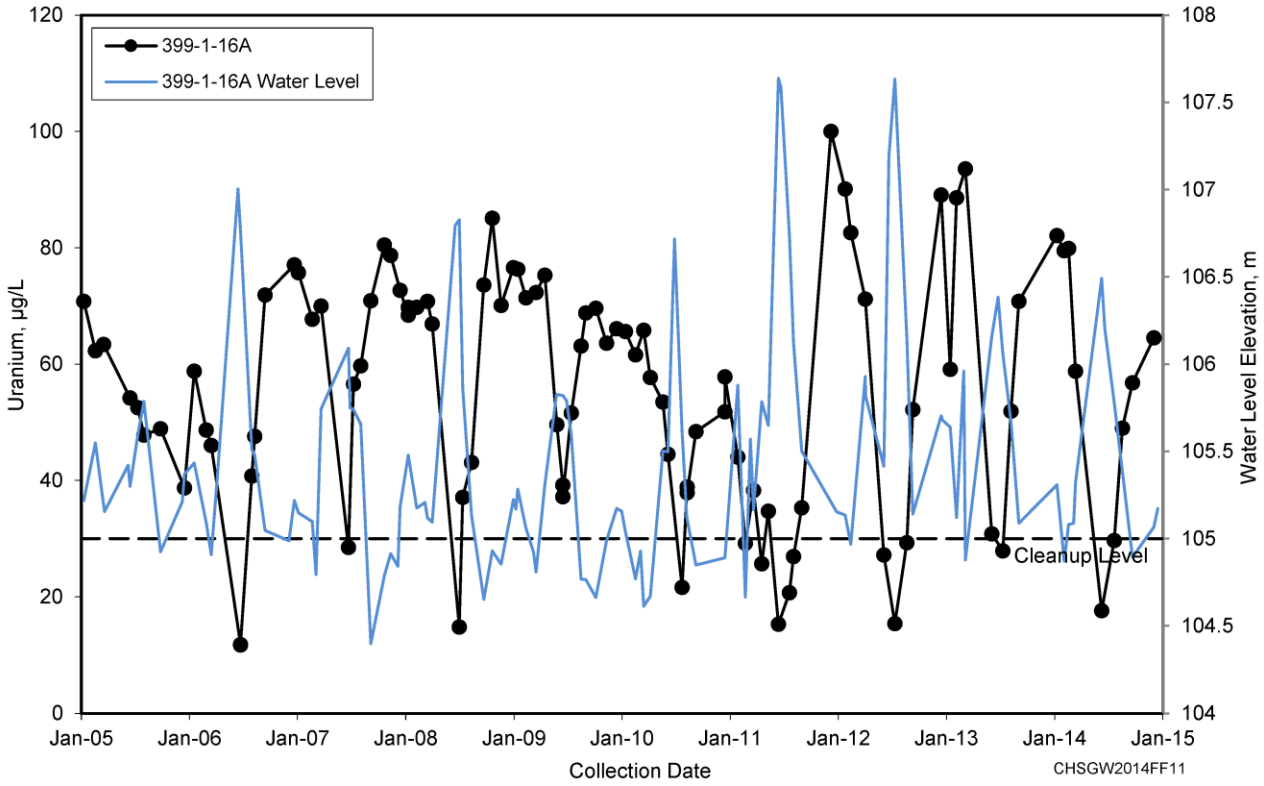

Figure 7-6. Uranium and Water-Level Data for Well 399-1-16A (Near River).

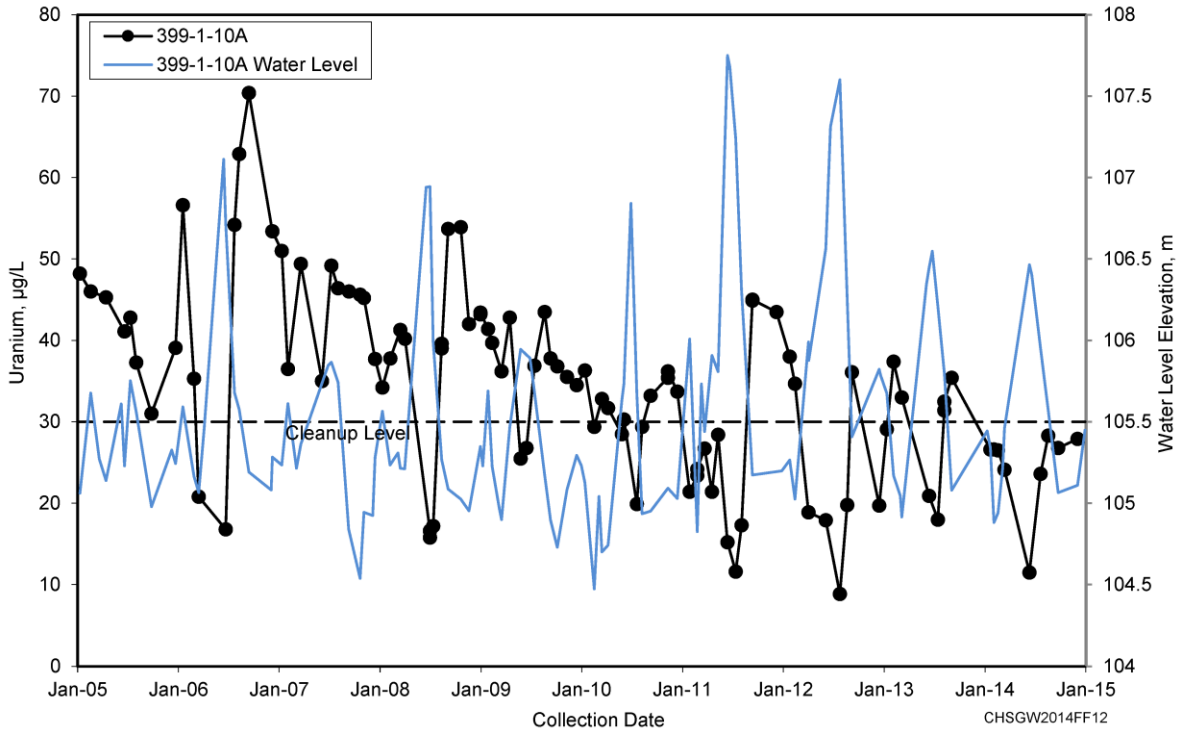

Figure 7-7. Uranium and Water-Level Data for Well 399-1-10A (Near River).

An area of uranium groundwater contamination developed in 2008 downgradient from the former 618-7 Burial Ground. The contaminant plume resulted from the infiltration of dust control water and soil fixatives used during remediation activities conducted at this site during 2007 and 2008. In addition to uranium, increases in the concentrations of chromium and constituents associated with soil fixatives (e.g., calcium and chloride) also occurred at Well 399-8-5A, which is adjacent to the waste site. By the end of 2010, concentrations at nearby downgradient Wells 399-8-5A and 399-8-1 continued to decrease, indicating passage of the contaminant plume (Figure 7-8). However, uranium concentrations increased again in samples collected after the seasonal high water table conditions in 2011 (August), in 2012 (August and November), and in 2013 (August), suggesting that mobile uranium remains in the lower portion of the vadose zone near Well 399-8-5A. The uranium plume appears to be recognizable along its projected migration path. Increases in uranium concentrations above the DWS were measured in January 2014 during low water conditions at the nearest downgradient well (399-8-1, approximately 340 m [1,100 ft] to the southeast) (Figure 7-5) and concentrations just below the DWS were measured during the following high water conditions at Well 399-1-59 (approximately 810 m [2,700 ft] to the southeast) (Figure 7-9).

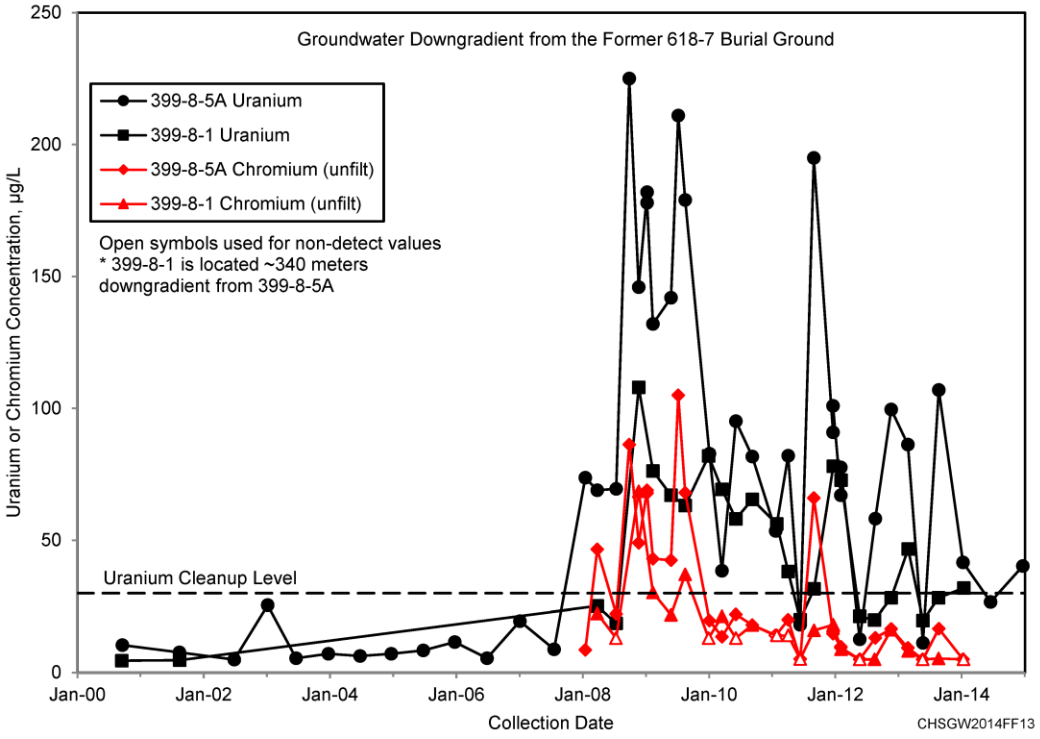

Figure 7-8. Uranium and Chromium Data for Wells 399-8-5A and 399-8-1, Downgradient of 618-7 Burial Ground.

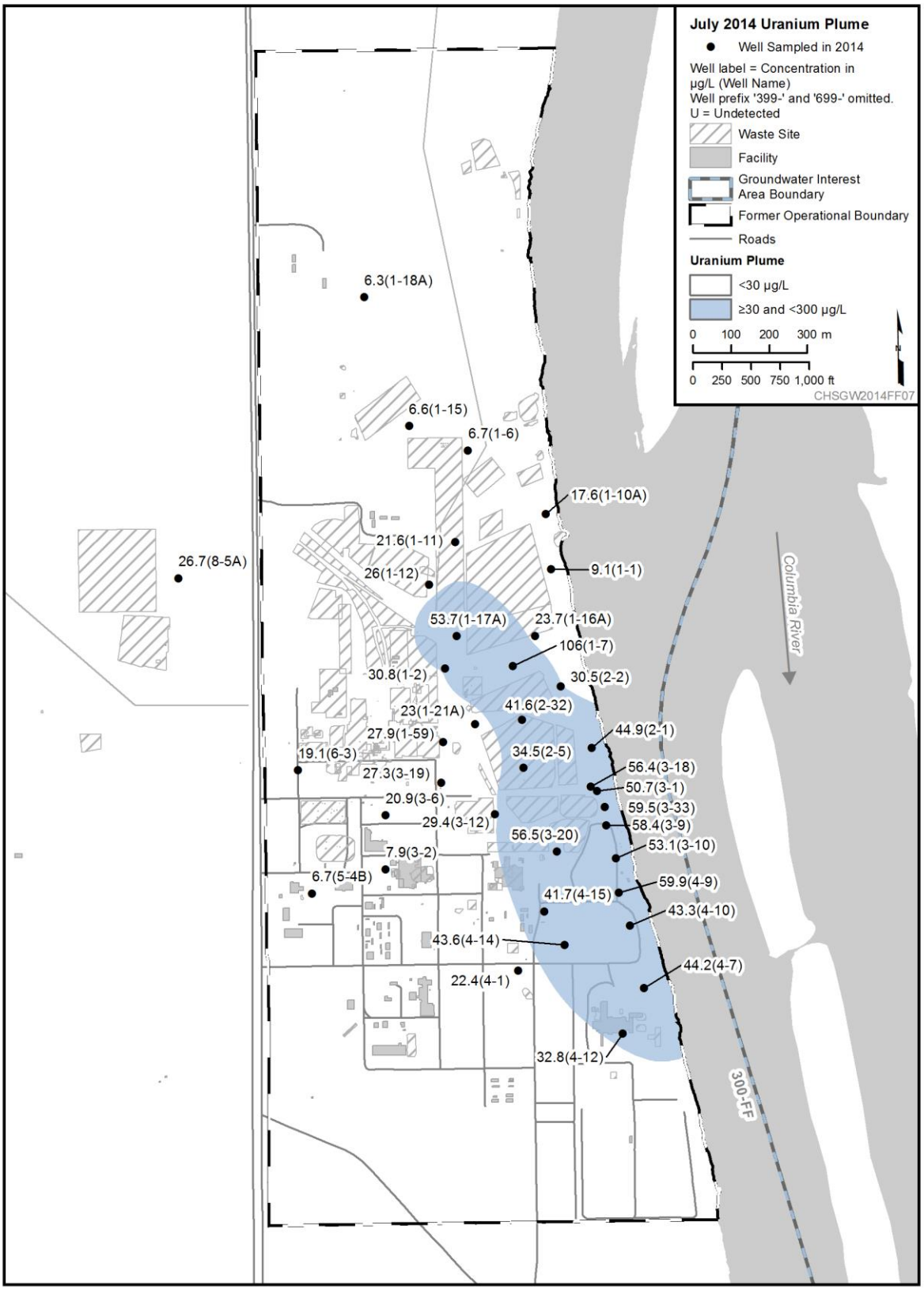

Figure 7-9. 300-FF Uranium, July 2014 (High River Stage)

Figure 7-10 shows the uranium concentrations observed in samples collected in December 2014 through January 2015 from aquifer tubes and near river monitoring wells. The lateral distribution of uranium, as indicated by the aquifer tube sample results, is consistent with the groundwater plume map for seasonal lower river stage conditions (Figure 7-5). The maximum uranium concentration in an aquifer tube was 127 µg/L (C6347) collected January 2014. Figure 7-11 illustrates the ranges of uranium concentrations detected over the period of aquifer tube monitoring in 300-FF. The concentrations in January 2015 in some of the downstream aquifer tubes were higher than those detected previously.

The contaminant concentrations measured in samples from aquifer tubes are lower than those in the approaching groundwater because river water intrudes into the unconfined aquifer beneath the shoreline, diluting the concentrations. A lowering of concentrations may also occur because of changes in geochemical conditions caused by the intrusion of river water, which could promote adsorption of dissolved uranium onto sediment near the river. The lower bicarbonate content of river water compared to groundwater enhances the tendency for adsorption, although the significance of this process with regard to influencing concentrations as observed in monitoring results is not known (Section 5.4 of PNNL-17031; Section 5.2 of Yabusaki et al., 2008; Section 5.1 of PNNL-22048).

Two river shore seeps at 300-FF were sampled in 2014 during low river stage. Seeps occur when groundwater drains from the aquifer, and the groundwater elevation locally is higher than the river elevation. The seep, which is exposed on the ground surface, is considered surface water rather than groundwater. The results of the seep analyses for uranium are shown as information on the plume map for that contaminant but were not used during preparation of the plume configuration.

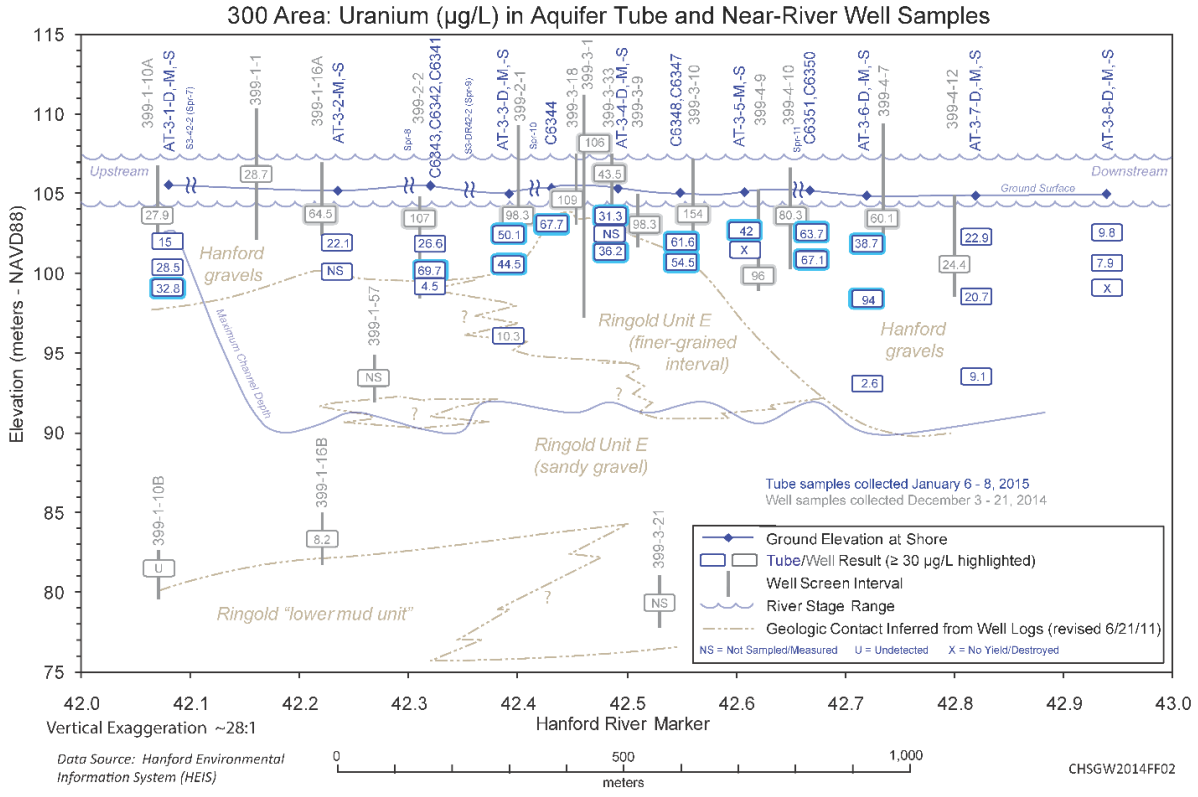

Figure 7-10. 300-FF Uranium in Aquifer Tube and Near-River Well Samples

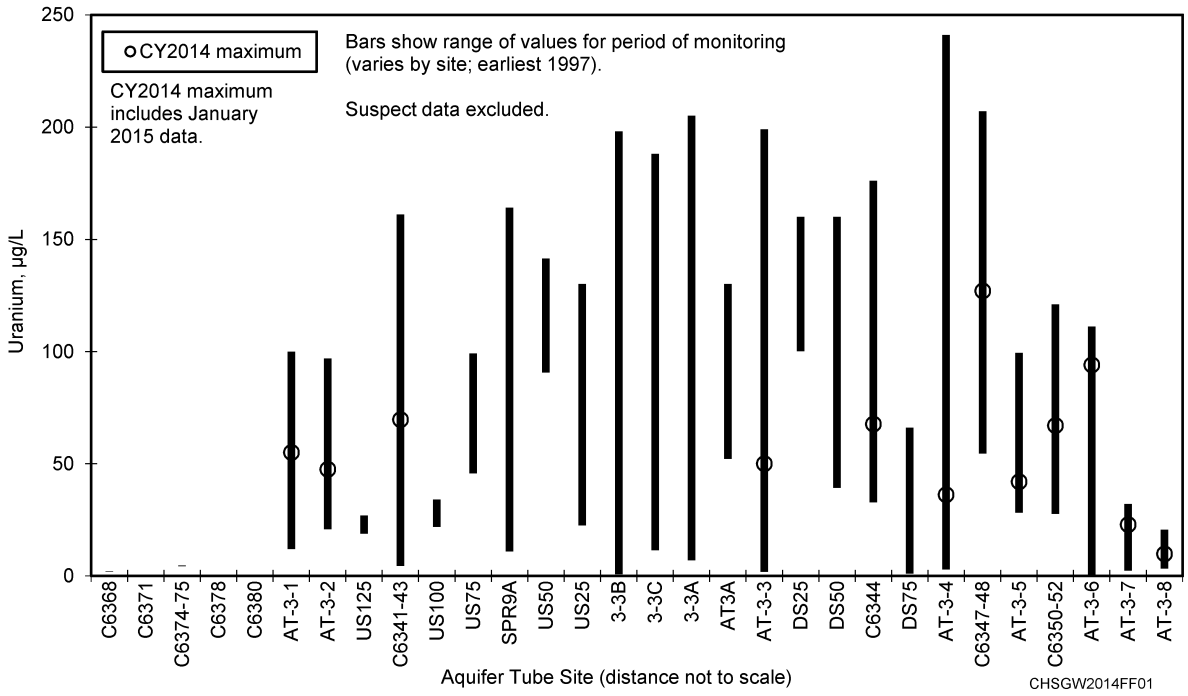

Figure 7-11. 300-FF Aquifer Tube Sample Data

Seep number "300 Area Spr DR 42-2," on the river shore downgradient from the 316-1 South Process Pond, was sampled on September 25, 2014. The uranium result was approximately 75.1 µg/L, based on the sum of uranium isotopic results. The uranium concentration in nearby Aquifer Tube C6341 was 26.6 µg/L in a sample collected on January 15, 2015. The uranium concentration in upgradient Well 399-2-2 was 107 µg/L in a sample collected on December 21, 2014.

Seep number "300 Area Spring 42-2," on the river shore downgradient from the 316-5 Process Trenches and 316-2 North Process Pond, was sampled on September 23, 2014. The uranium result was approximately 19.5 µg/L, based on the sum of uranium isotopic results. The uranium concentrations in nearby Aquifer Tubes AT-3-1-D, AT-3-1-M, and AT-3-1-S were 32.8 µg/L, 28.5 µg/L, and 15 µg/L, respectively, in samples collected in January 2015. The uranium concentration in upgradient Well 399-1-10A was 27.9 µg/L in December 2014.

Uranium concentrations also are detected in groundwater near the 618-10 Burial Ground/316-4 Crib, located northwest of the 300 Area Industrial Complex (Figure 7-4). From 1948 to 1956, uranium contaminated organic solvents were disposed to the 316-4 Crib, which is adjacent to the easternmost corner of the 618-10 Burial Ground (Section 3.6.33 of BHI-00012, *300-FF-3 Operable Unit Technical Baseline Report*). The crib and some of the contaminated adjacent soil were removed in 2003 and 2004, and the site was partially backfilled. However, some uranium contamination was known to remain in the soil beneath the excavated site (Sections 3.4.1.4 and 3.4.2.1 of DOE/RL-2006-20; EPA/ESD/R10-00/524).

Uranium concentrations increased above the DWS in 2004 in Wells 699-S6-E4A and 699-S6-E4L near the southeastern fence line of the 618-10 Burial Ground and the 316-4 Crib. This increase was caused by infiltration of dust control water applied during the 316-4 Crib excavation and backfilling. Concentrations were elevated again in Well 699-S6-E4L in 2012 and 2013 and still above the DWS in 2014 (2014 maximum was 47.7 µg/L) (Figure 7-12). The 2012 and 2013 increases are attributed to infiltration of dust

control water during removal actions that started in 2011 at the 618-10 Burial Ground. Because the water table elevation in this area has steadily declined by 1 m (3.3 ft) since 1998, the increase in uranium is not attributed to rewetting of the vadose zone by seasonal changes in the water table.

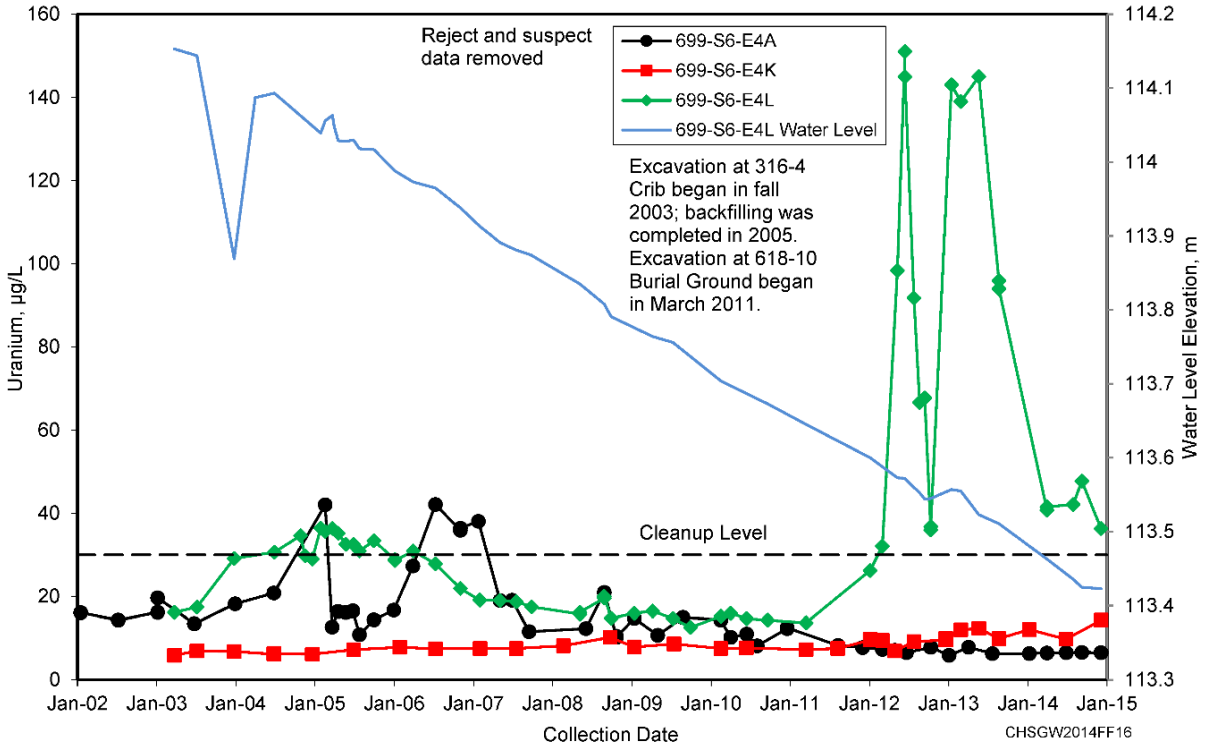

Figure 7-12. Uranium and Water-Level Data for Wells 699-S6-E4A, 699-S6-E4K, and 699-S6-E4L

7.3.2 Uranium at High River Stage

Uranium concentrations for the seasonal high water table conditions in June 2014 are shown on Figure 7-9. Groundwater elevations were high during April through August 2014. The water table was elevated sufficiently to rewet a portion of the vadose zone where residual amounts of mobile uranium remain at some locations. The rewetting of the vadose zone mobilized uranium into the groundwater causing higher concentrations in several wells adjacent to the former 300 Area Process Trenches (316-5) and the North Process Pond (316-2) (Figures 7-13, 7-14, and 7-15). The positive correlation between water table elevation and uranium concentration suggests that at or near these locations, uranium remains in the lower portion of the vadose zone and is available to be remobilized during periods of high water table conditions. During low water conditions, these high concentrations declined to more typical seasonal values. Elevated uranium concentrations measured in the downgradient wells the following winter likely reflect the migration of the elevated uranium concentrations measured farther inland in the summer.

Typical characteristics of the plume during seasonal high water table conditions include lowered concentrations along portions of the Columbia River shoreline and increased concentrations farther inland near source areas. The reduction in concentrations near the shoreline is caused by dilution from intrusion of river water into the aquifer, as evidenced by lower specific conductance measured in wells near the shoreline during high river stage. The increase in concentrations near source areas is caused by mobilization of residual contamination resulting from temporary elevation of the water table.

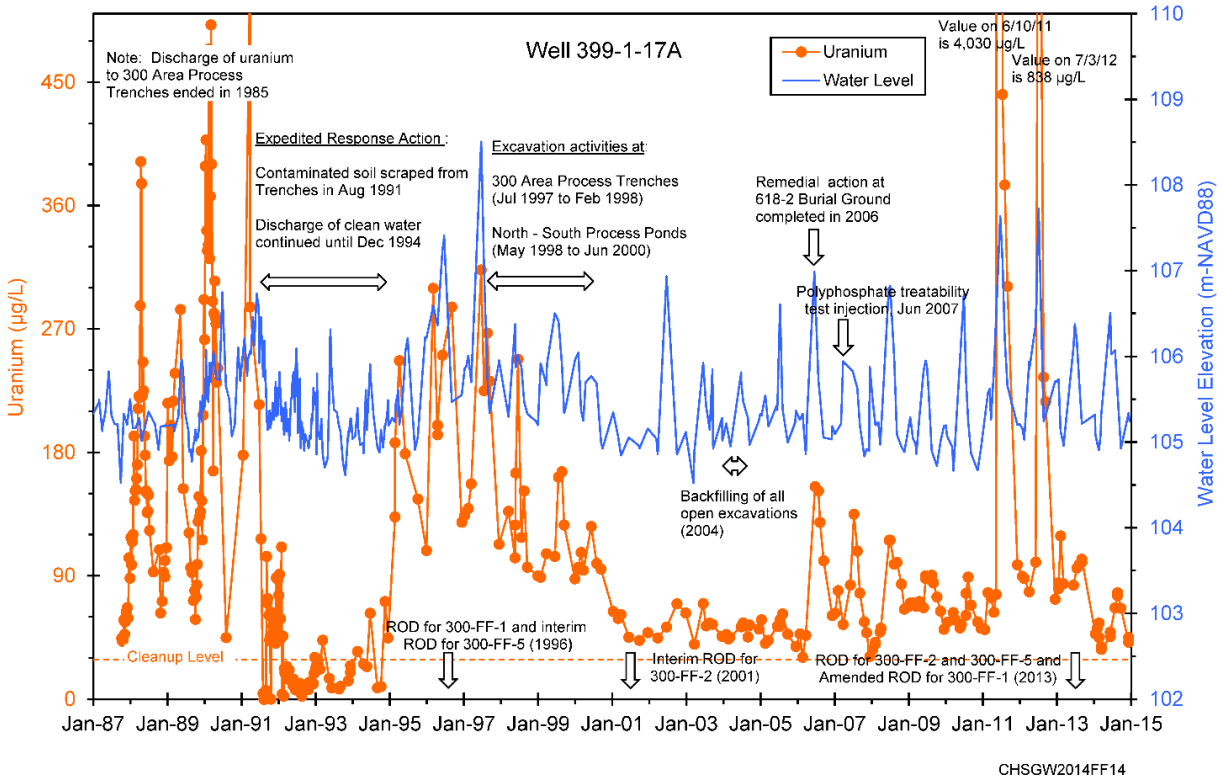

Figure 7-13. Uranium and Water-Level Data for Well 399-1-17A (Inland)

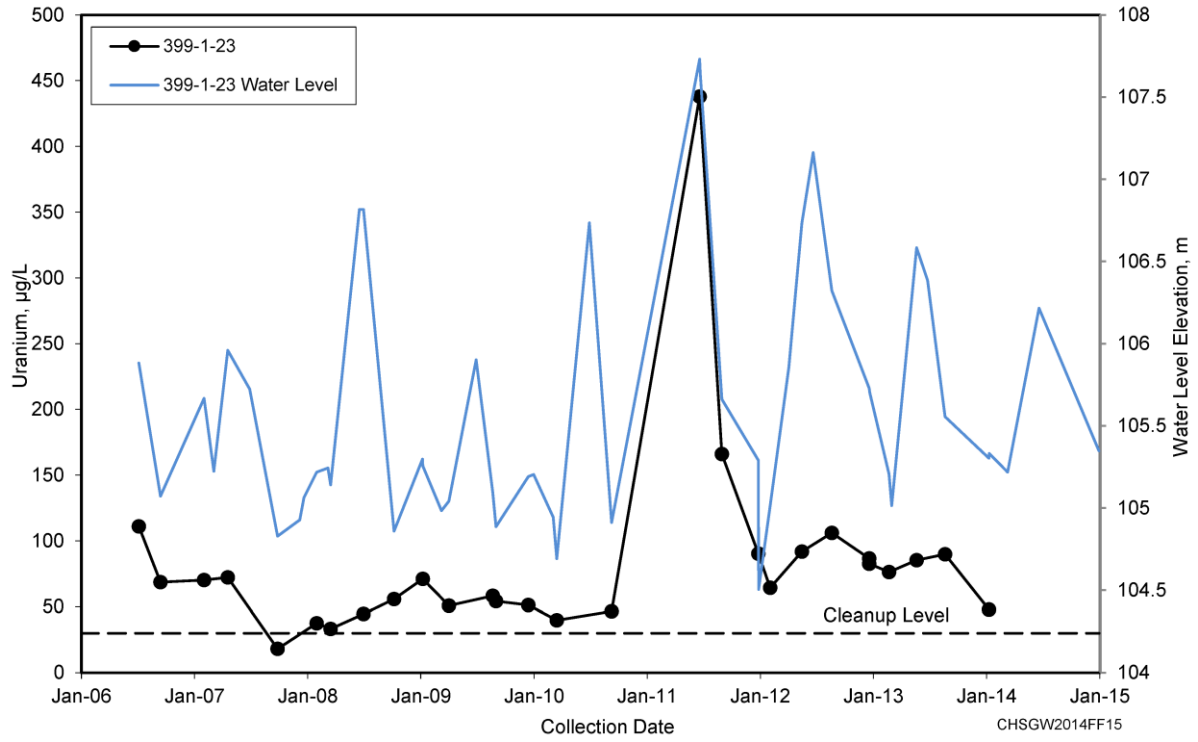

Figure 7-14. Uranium and Water-Level Data for Well 399-1-23 (Inland)

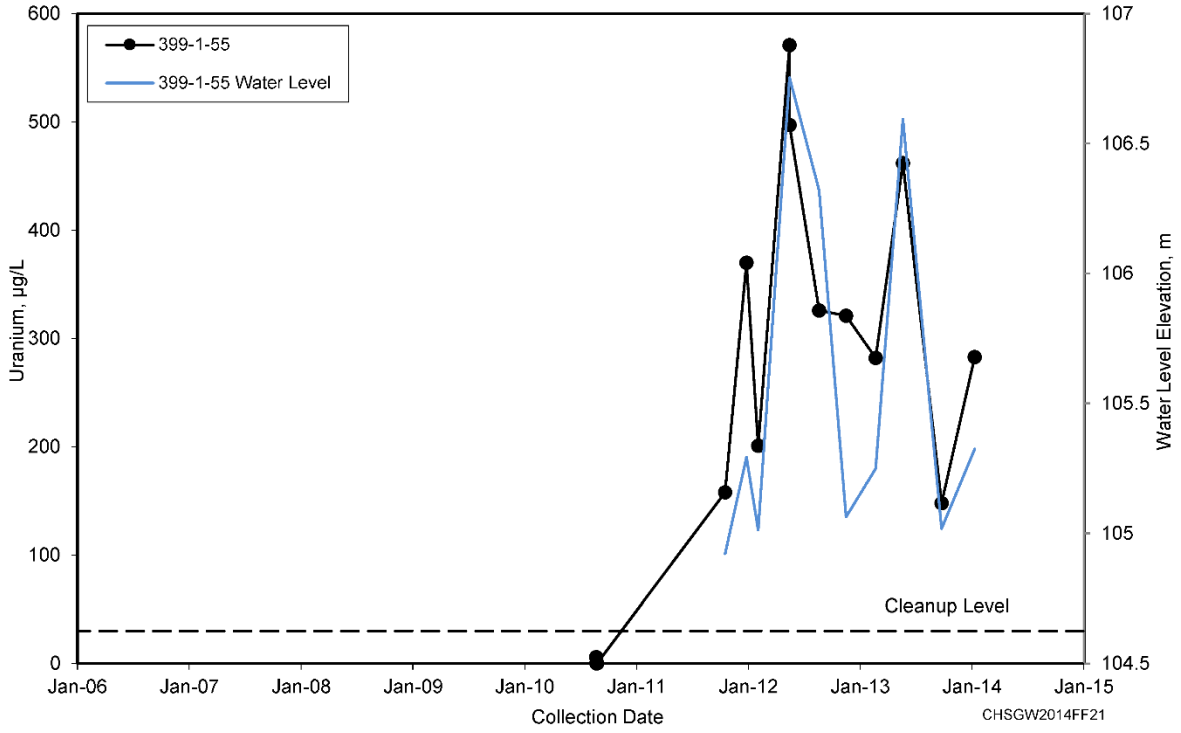

Figure 7-15. Uranium and Water-Level Data for Well 399-1-55 (Inland)

Uranium concentrations in wells that monitor the lower portion of the unconfined aquifer in the 300 Area Industrial Complex are typical of natural background levels (estimated to range between 0.5 and 12.8 µg/L [Table ES-1 of DOE/RL-96-61]), indicating little or no downward migration of contaminant uranium below the saturated Hanford formation sediment. Hydrographs for wells screened in saturated Hanford formation sediment or underlying Ringold Formation unit E sediment are virtually identical, indicating no significant vertical gradients.

Contamination has not been detected in the few wells that monitor the uppermost confined aquifer, which is a low to moderately permeable interval within the Ringold Formation lower mud unit. Hydrographs for two of these confined wells (399-1-16C and 399-1-17C) show a distinct upward hydraulic gradient, with hydraulic heads approximately 8 to 9 m (26 to 30 ft) higher than in adjacent water-table wells. These two deep wells are screened across the basalt/Ringold lower mud contact and show confined basalt aquifer conditions. The hydrograph for a third well identified as a confined well (399-1-18C) shows very little head difference compared to the adjacent water-table well. Because Well 399-1-18C is responding similarly to the unconfined and confined Ringold aquifers, it was completed in the lowest Ringold sediment rather than in the basalt-confined aquifer.

Gross alpha activity in 300-FF is attributed to uranium and exceeded the cleanup level (15 pCi/L, DWS) at numerous wells in the 300 Area Industrial Complex groundwater where uranium concentrations were also elevated during the high water table conditions in 2013. Uranium and gross alpha activity also exceeded the DWS at the 618-10 Burial Ground and the 316-4 Crib. However, the ROD (EPA et al., 2013) does not name those constituents as COCs at that location.

7.4 Tritium

Tritium is found in groundwater associated with the 618-11 Burial Ground at concentrations exceeding the cleanup level (20,000 pCi/L, DWS). The source of the plume is tritium gas released from buried radiological solid wastes in a series of caissons located along the north side of the burial ground (PNNL-13675). The narrow tritium plume extends for approximately 1.2 km (0.7 mi) to the east of (downgradient from) the 618-11 Burial Ground. The plume passes just to the north of the Energy Northwest Columbia Generating Station (Figure 7-16). The plume appears to be contained within the saturated Hanford formation gravels portion of the unconfined aquifer. The tritium concentrations attributed to the 618-11 Burial Ground lie within the larger, lower concentration tritium plume that is part of 200-PO (Section 4.4.5 of DOE/RL-2010-99).

Tritium concentrations near the 618-11 Burial Ground have declined from the maximum values observed in 1999 and 2000 (Figure 7-17). The trend in groundwater at Well 699-13-3A, adjacent to the eastern fence line of the burial ground, suggests that an episodic event of unknown nature caused a tritium release from buried materials to contaminate groundwater. The relatively constant tritium concentrations at Well 699-13-3A since 2006 suggest that buried materials are providing an ongoing source of tritium to groundwater. At wells farther downgradient from the 618-11 Burial Ground, such as Wells 699-13-2D and 699-12-2C, concentration trends reflect the plume's migration. The conceptual model for the plume, including a simulation of plume evolution over time, indicates that tritium concentrations will be below the cleanup level when the plume reaches the Columbia River (Section 5.1 of PNNL-15293). Groundwater wells monitored by Energy Northwest do not show evidence of this plume above the DWS, and tritium is not detected in Energy Northwest water supply wells (Mee, 2014).

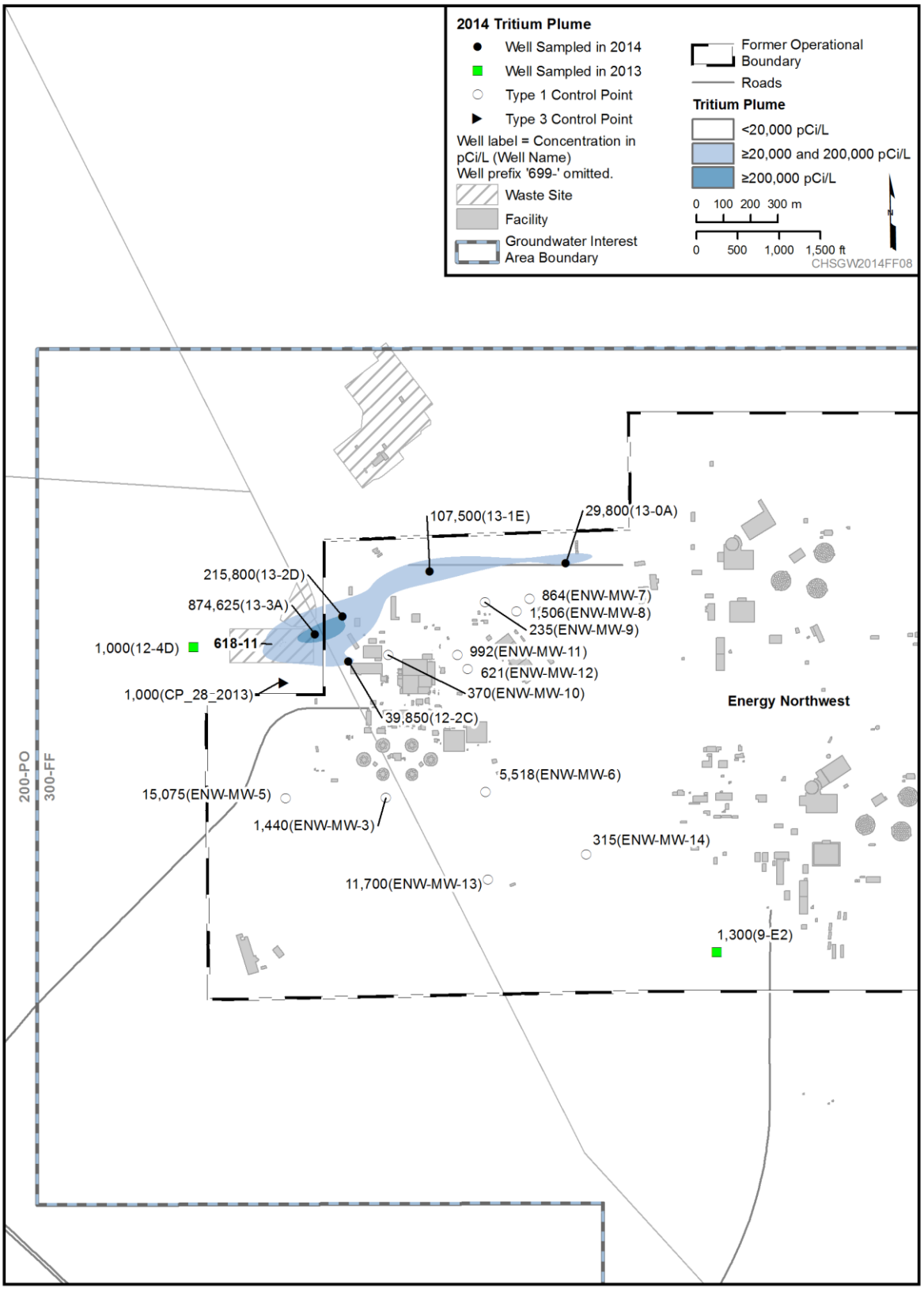

Figure 7-16. Tritium near the 618-11 Burial Ground

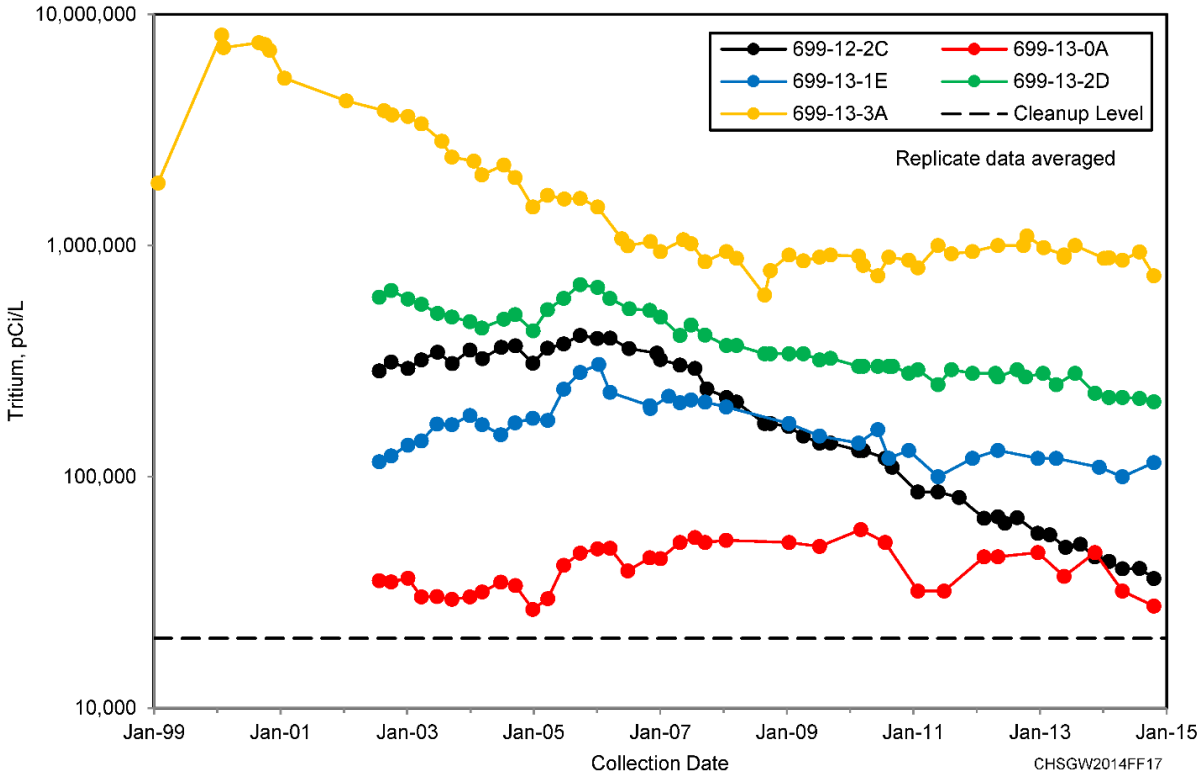

Figure 7-17. 300-FF Tritium Data for Wells 699-12-2C, 699-13-0A, 699-13-1E, 699-13-2D, and 699-13-3A

7.5 Nitrate

Nitrate concentrations exceeding the 45 mg/L cleanup level (DWS [10 mg/L measured as nitrogen in nitrate]) are found near the 618-11 Burial Ground (Figure 7-18). Nitrate exceeding 45 mg/L also is found in the southern portion of the 300 Area Industrial Complex. The principal sources of nitrate currently observed in 300 Area Industrial Complex groundwater are agricultural and industrial activities not associated with the Hanford Site. The nitrate in the southern portion of the 300 Area Industrial Complex is not part of the 300-FF-5 OU (EPA et al., 2013).

7.5.1 618-11 Burial Ground

Nitrate concentrations near the 618-11 Burial Ground continue to exceed the cleanup level (Figures 7-18, 7-19, and 7-20). Concentrations at Well 699-13-3A have generally decreased since 2010; the maximum concentration during 2014 was 83.2 mg/L (Figure 7-19). Historical records for materials sent to the 618-11 Burial Ground do not indicate significant quantities of nitrate-bearing wastes. Given that the elevated nitrate contamination in the groundwater corresponds to the elevated tritium contamination, which is attributed to the 618-11 Burial Ground, the nitrate contamination is also attributed to the 618-11 Burial Ground (Section 4.4.5 of DOE/RL-2010-99).

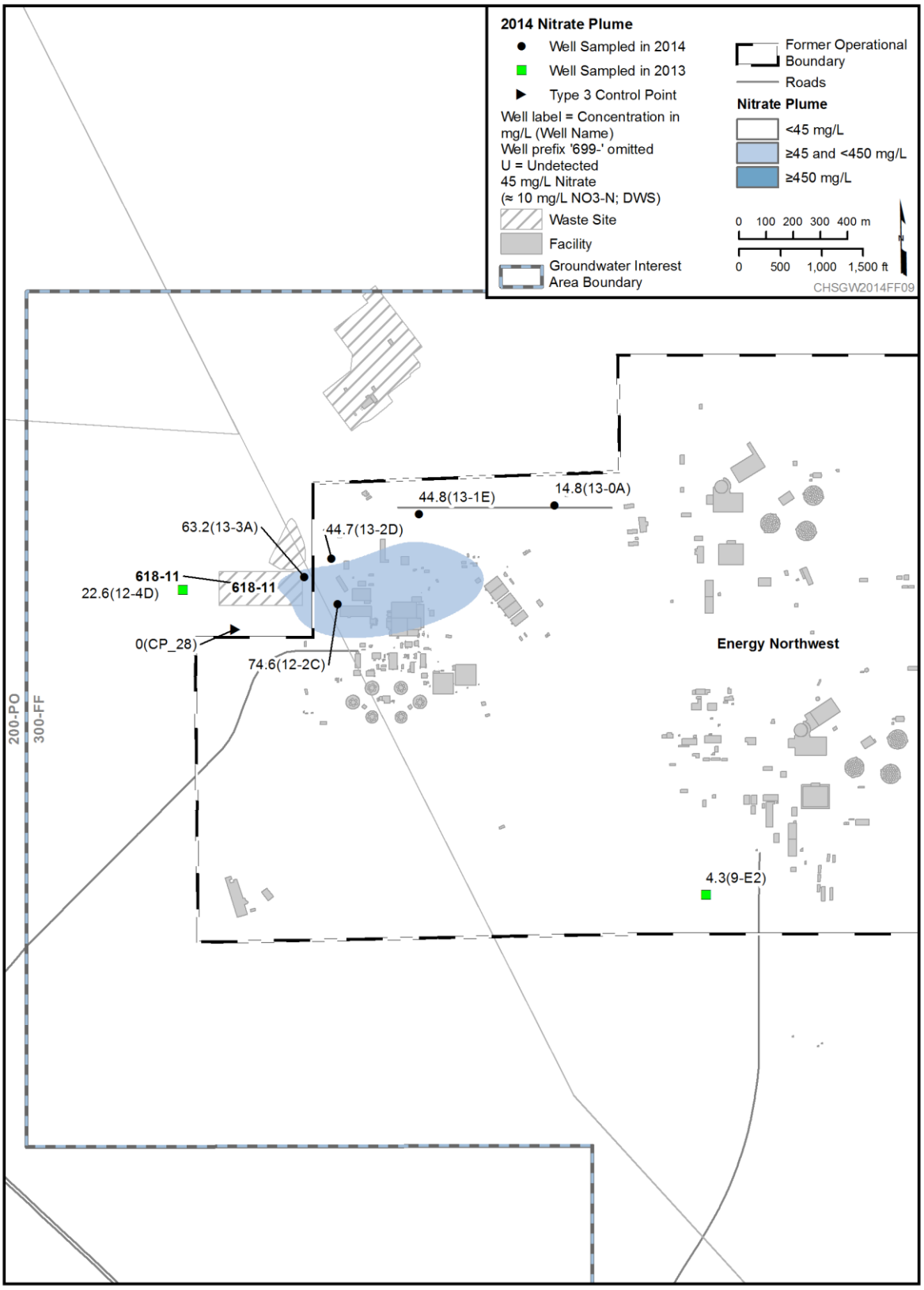

Figure 7-18. Nitrate near the 618-11 Burial Ground

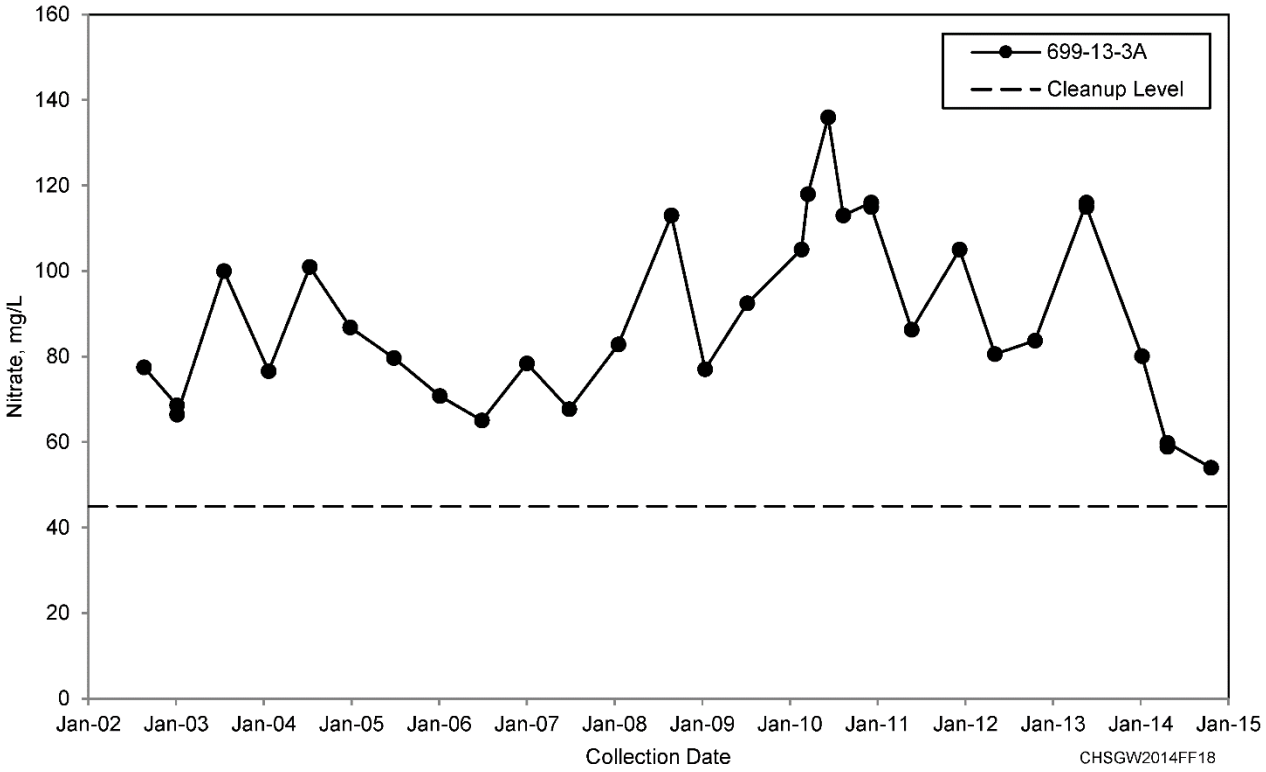

Figure 7-19. Nitrate Data for Well 699-13-3A

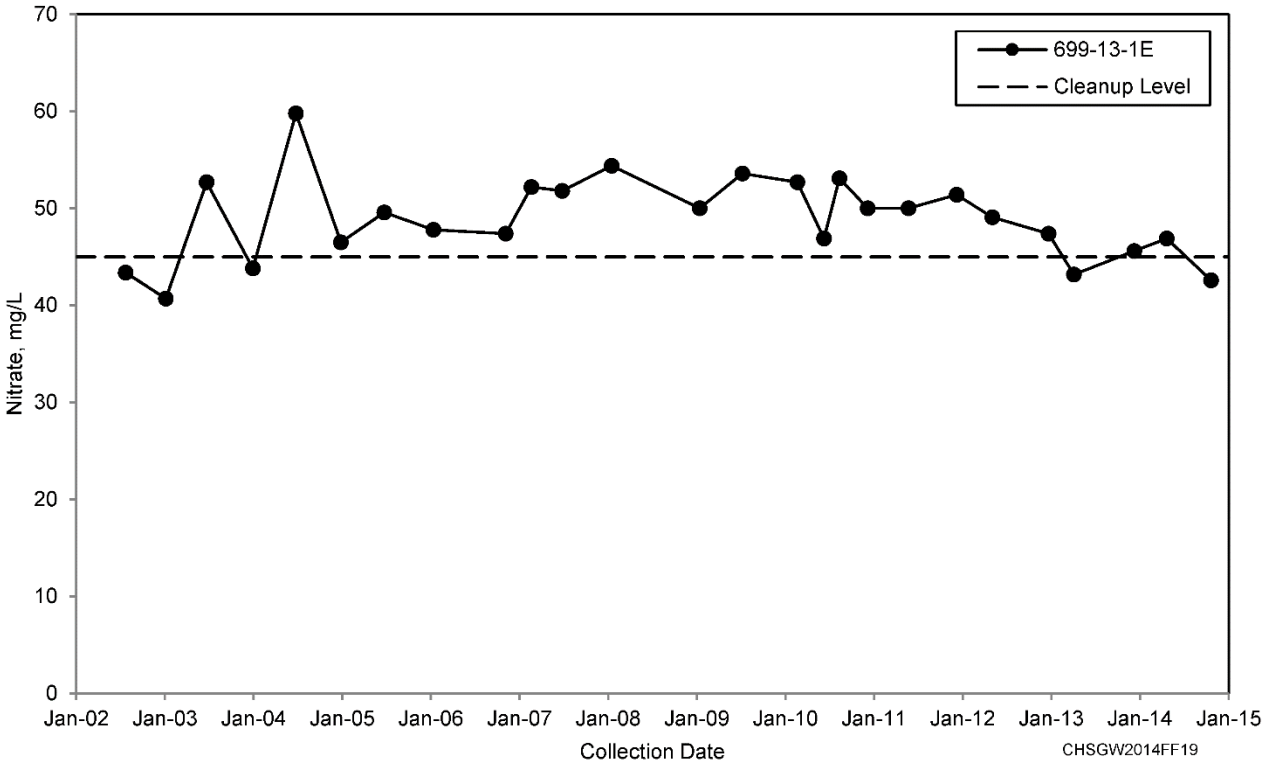

Figure 7-20. Nitrate Data for Well 699-13-1E

7.5.2 300 Area Industrial Complex

The nitrate concentrations exceeding the DWS in the southern portion of the 300 Area Industrial Complex reflect the migration of nitrate contaminated groundwater into the 300 Area Industrial Complex from sources to the southwest. For example, the maximum nitrate concentration near the southwestern corner of the 300 Area Industrial Complex (at Well 699-S28-E12 in the 1100-EM interest area) was 193 mg/L in April 2013, and the concentration at Well 699-S27-E14, approximately 616 m (2,021 ft) to the northeast, was 95.6 mg/L in April 2013. Nitrate also migrates into the 300 Area Industrial Complex from the northwest as part of the sitewide plume that originates in the 200 East Area, with concentrations typically ranging from 25 to 30 mg/L.

Seep number "300 Area Spr DR 42-2", on the river shore downgradient from the 316-1 South Process Pond, was sampled on September 3, 2013. The nitrate result was 21.9 mg/L. The nitrate concentration in upgradient Well 399-2-2 was 24.4 mg/L in January 2014.

Seep number "300 Area Spring 42-2", on the river shore downgradient from the 316-5 Process Trenches and 316-2 North Process Pond, was sampled on September 4, 2013 and had a nitrate concentration of 15.3 µg/L. The nitrate concentrations in nearby Aquifer Tube AT-3-1-M and in upgradient Well 399-1-10A were 14 and 25.5 mg/L, respectively, in January 2014.

7.6 Trichloroethene and *cis*-1,2-Dichloroethene

Two volatile organic compounds (VOCs), TCE and DCE, are found in localized areas in groundwater beneath the 300 Area Industrial Complex at concentrations exceeding their cleanup levels. DCE is a degradation product of TCE and tetrachloroethene (PCE). The original compounds degrade by dechlorination under conditions that include very low oxygen and the presence of certain types of microbes (Section 1.2 of PNNL-17666).

TCE and PCE were widely used in the 300 Area Industrial Complex in degreasing operations associated with the fuels fabrication process (Section 3.3.4 of BHI-00012, *300-FF-2 Operable Unit Technical Baseline Report*; Section 2.0 of EMO-1026; Section 1.0 of WHC-MR-0388). TCE was the primary degreaser used until the 1970s, followed by PCE in the 1970s and 1980s. TCE and PCE were discharged to the South Process Pond (316-1) and North Process Pond (316-2). PCE was evaluated in the RI/FS and was not found to be a COC in the 300 Area.

TCE concentrations exceeded the cleanup level (4 µg/L) in 2014 in one 300-FF well, 399-1-7 (5.8 µg/L).

During drilling in 2006, TCE (maximum concentration of 630 µg/L) was encountered in groundwater associated with an interval of relatively finer grained sediment within Ringold Formation unit E (Section 2.1 of PNNL-17666). Because this finer grained interval has a very low permeability and does not readily yield groundwater, monitoring wells have not been screened in this interval. This interval is incised by the river channel. Contamination slowly migrates within these sediments and into overlying or adjacent permeable Hanford formation sediment, as evidenced by periodic detections of TCE in aquifer tube samples that are collected from screens positioned near this contact (Section 4.8.4.4 of DOE/RL-2010-99).

TCE was detected in 2014 at concentrations exceeding the cleanup level at two aquifer tubes that are screened proximal to, or within, the finer grained interval of Ringold Formation sediment that is contaminated by TCE (Figure 7-21). Consistent with results from previous years, the highest concentrations (430 µg/L in December 2013 and 370 µg/L in January 2015) were observed at AT-3-3-D, which is the aquifer tube believed to be placed in the finer grained interval of Ringold Formation unit E sediment. Elevated concentrations are also consistently observed at AT-3-7-D, where the highest TCE

concentrations in January 2014 and January 2015 were 83 and 78.1 µg/L, respectively. The origin for the TCE in groundwater at this aquifer tube is not known, but is most likely associated with past disposal of TCE used in the manufacture of nuclear fuel.

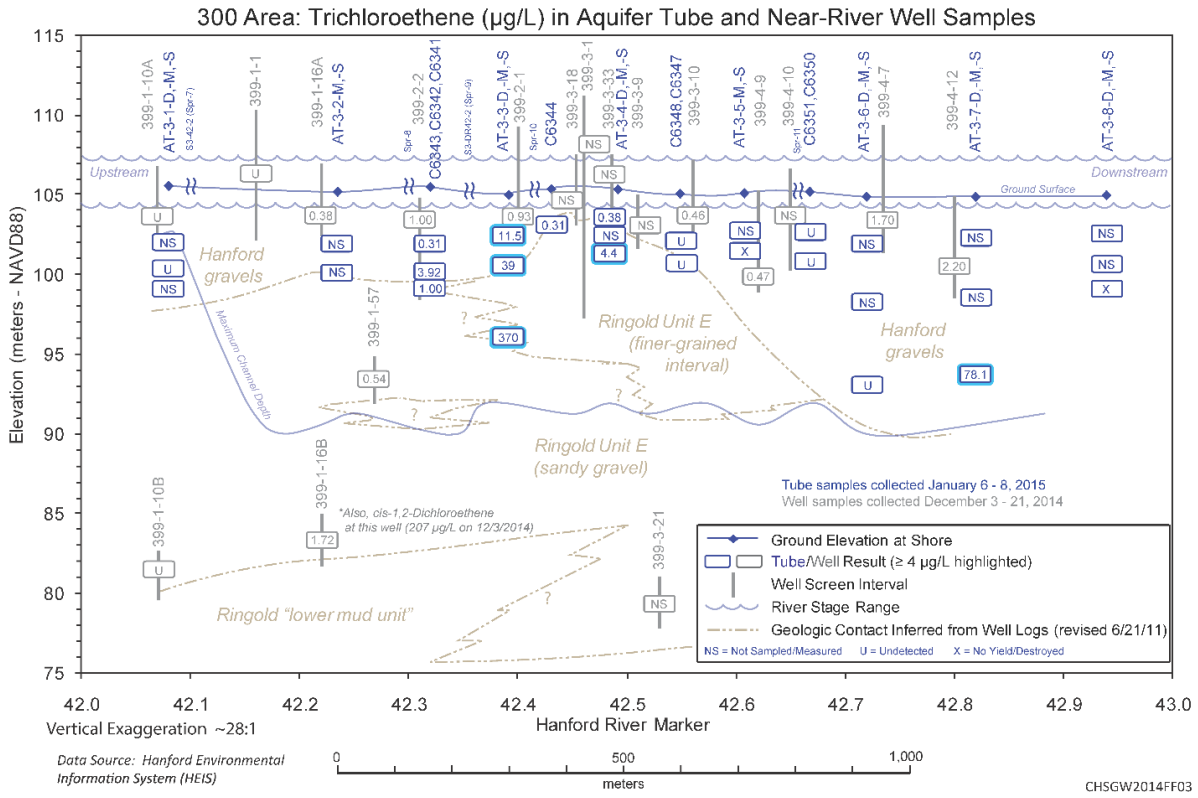

Figure 7-21. TCE in Aquifer Tube and Near-River Well Samples

Seep number "300 Area Spr DR 42-2," on the river shore downgradient from the 316-1 South Process Pond, was sampled on September 25, 2014, and had no detectable TCE. The TCE concentration in nearby Aquifer Tube C6341 was estimated at 0.31 µg/L in a sample collected on January 6, 2015. The TCE concentrations in upgradient Well 399-2-2 was 1.0 µg/L in December 2014.

Seep number "300 Area Spring 42-2," on the river shore downgradient from the 316-5 Process Trenches and 316-2 North Process Pond, was sampled on September 23, 2014, and had no detectable TCE. The TCE concentrations in nearby Aquifer Tube AT-3-1-M and in upgradient Well 399-1-10A were less than 0.3 µg/L in January 2015 and December 2014, respectively.

In the lower portion of the unconfined aquifer, DCE concentrations continue to exceed the cleanup level (16 µg/L) at one well (399-1-16B). The maximum concentration in 2014 was 207 µg/L (Figure 7-22). Well 399-1-16B is downgradient from the 300 Area Process Trenches (316-5) and North Process Pond (316-2). It is screened in Ringold Formation gravelly sediment. The elevation of the well's screen is approximately 7 m (23 ft) deeper than the elevation of the Columbia River's maximum channel depth (Section 4.4.4.5 of DOE/RL-2010-99). The origin for DCE is likely degradation of TCE and/or PCE disposed to the former North Process Pond (316-2) and/or 300 Area Process Trenches (316-5) (Sections 3.1 and 3.3 of PNNL-17666; Section 4.4.4.5 of DOE/RL-2010-99). The DCE concentration (62 µg/L) also exceeded the cleanup level in 2014 in a sample from Well 399-1-57, which is located 80 m (262.5 ft) to the southeast of 399-1-16B, and screened at mid-depth in the unconfined

aquifer in the Ringold Formation unit E sandy gravel; the lowest extent of the screen just enters the top of the finer grained interval within the Ringold unit E (p. 4-221 of DOE/RL-2010-99).

DCE concentrations did not exceed the cleanup level in 2014 in any 300-FF aquifer tubes. The maximum concentration (12.1 µg/L) was observed at AT-3-3-D in January 2015.

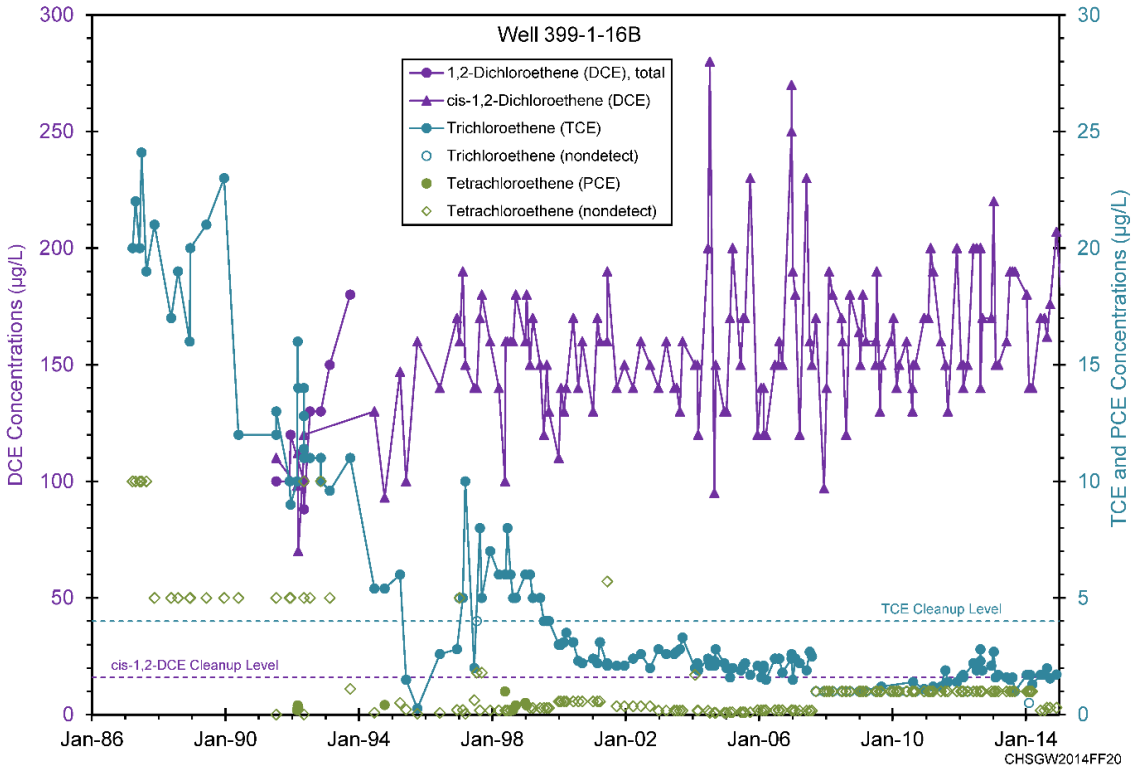

Figure 7-22. 300-FF DCE, TCE, and PCE Data for Well 399-1-16B

7.7 RCRA – 316-5 Process Trenches

One unit in the 300-FF interest area, the former 300 Area Process Trenches (316-5), is monitored per the Hanford Facility RCRA Permit WA7890008967. The 316-5 Process Trenches received effluent discharges of mixed waste from fuel fabrication and nuclear research laboratories in the 300 Area Industrial Complex from 1975 through 1987, followed by continued discharge of cooling water with small quantities of nonhazardous maintenance and process waste until December 1994. A comprehensive description of the facility and its history of operations is provided in Section 2.1 of PNNL-13645.

The trenches were remediated in 1991 under a CERCLA expedited response action by scraping contaminated soil to the north end of the facility (DOE/RL-92-32). Additional removal actions were performed in 1997 and 1998, followed by backfilling and surface restoration in 2004 (Section 3.0 of DOE/RL-2004-74). The modified closure plan (DOE/RL-93-73), which is incorporated into the Hanford Facility RCRA Permit WA7890008967, states that groundwater remediation is deferred to 300-FF-5 under CERCLA. The RDR/RA WP for 300-FF groundwater will describe the work elements and schedule for implementing the remedy selected in the 2013 CERCLA ROD (Section 7.2). The treatment area for uranium sequestration will be in the vicinity of the former 300 Area Process Trenches.

Groundwater monitoring to meet RCRA requirements is conducted in accordance with WHC-SD-EN-AP-185. The constituents monitored under this plan include chemical uranium, TCE,

and DCE. Uranium as a metal was included in the monitoring plan as an indicator and was incorporated by reference in the Hanford Facility RCRA Permit WA7890008967. The Permit concentration limits for TCE, and DCE are 5 µg/L and 70 µg/L, respectively; the DWS for uranium is 30 µg/L. Table B-39 in Appendix B summarizes data from 2014.

RCRA post-closure groundwater monitoring under the corrective action program of WAC 173-303-645 uses wells at four locations: one upgradient (northwest) and three downgradient (east, southeast, and south) of the former 300 Area Process Trenches (Figure 7-23). The most distant downgradient location is approximately 200 m (660 ft) to the southeast, along the dominant groundwater flow path from the trenches. Groundwater flows generally toward the south southeast beneath the former trenches. In March 2014, the gradient sloped to the south and the estimated groundwater flow rate was 17 m/d (56 ft/d) (Table B-1, Appendix B).

Two wells are at each of the four locations (Figure 7-23). The well with the well number ending in "A" is screened near the water table, and the well with the well number ending in "B" is screened in the lower portion of the unconfined aquifer (Table B-38, Appendix B). The sampling schedule for the eight wells is designed to accommodate two semiannual sampling events, with four time-independent samples collected during each period to provide data amenable to statistical analysis. As a result, the wells are sampled during 8 months of the year: the first sampling event covers December, January, February, and March; and the second sampling event covers June, July, August, and September. During 2014, sampling was performed as planned (Table B-37, Appendix B). Reports on the effectiveness of the corrective action monitoring program were prepared semiannually in accordance with WAC 173-303-645. The results for 2014 are provided in SGW-58475 and SGW-58600.Analytical results for TCE were all below the detection limit during 2014, with the exceptions of (1) eight samples from Well 399-1-16B, where the maximum concentration was estimated to be 1.99 µg/L; (2) three samples from Well 399-1-16A, where the maximum concentration was estimated to be 0.42 µg/L; and (3) two samples from Well 399-1-17A, where the maximum concentration was estimated to be 0.41 µg/L. Analytical results for DCE were all below the detection limit during 2014, with the exception of (1) all nine samples from Well 399-1-16B, where concentrations ranged from 140 to 207 µg/L (see Section 7.6); (2) three samples from Well 399-1-16A, where the maximum concentration was estimated to be 0.25 µg/L; and (3) eight samples from Well 399-1-17B, where the maximum concentration was estimated to be 4.45 µg/L.

Uranium was detected at six of the monitoring wells in 2014. In the three downgradient wells screened in the upper portion of the unconfined aquifer, maximum concentrations ranged from 28.3 to 82.1 µg/L (see Section 7.3). Concentrations at Wells 399-1-10A and 399-1-16A, which are near the Columbia River, declined in early summer when the river stage was high and increased in autumn with the arrival of uranium that had been remobilized upgradient. Concentrations at upgradient Well 399-1-18A are consistent with background levels for saturated Hanford formation sediment and ranged from 5.5 to 6.30 µg/L during 2014. Concentrations in the lower portion of the unconfined aquifer were typically below detection levels, with the exception of Well 399-1-16B, where the maximum concentration was 10.4 µg/L. Uranium is reported as total uranium in an unfiltered sample.

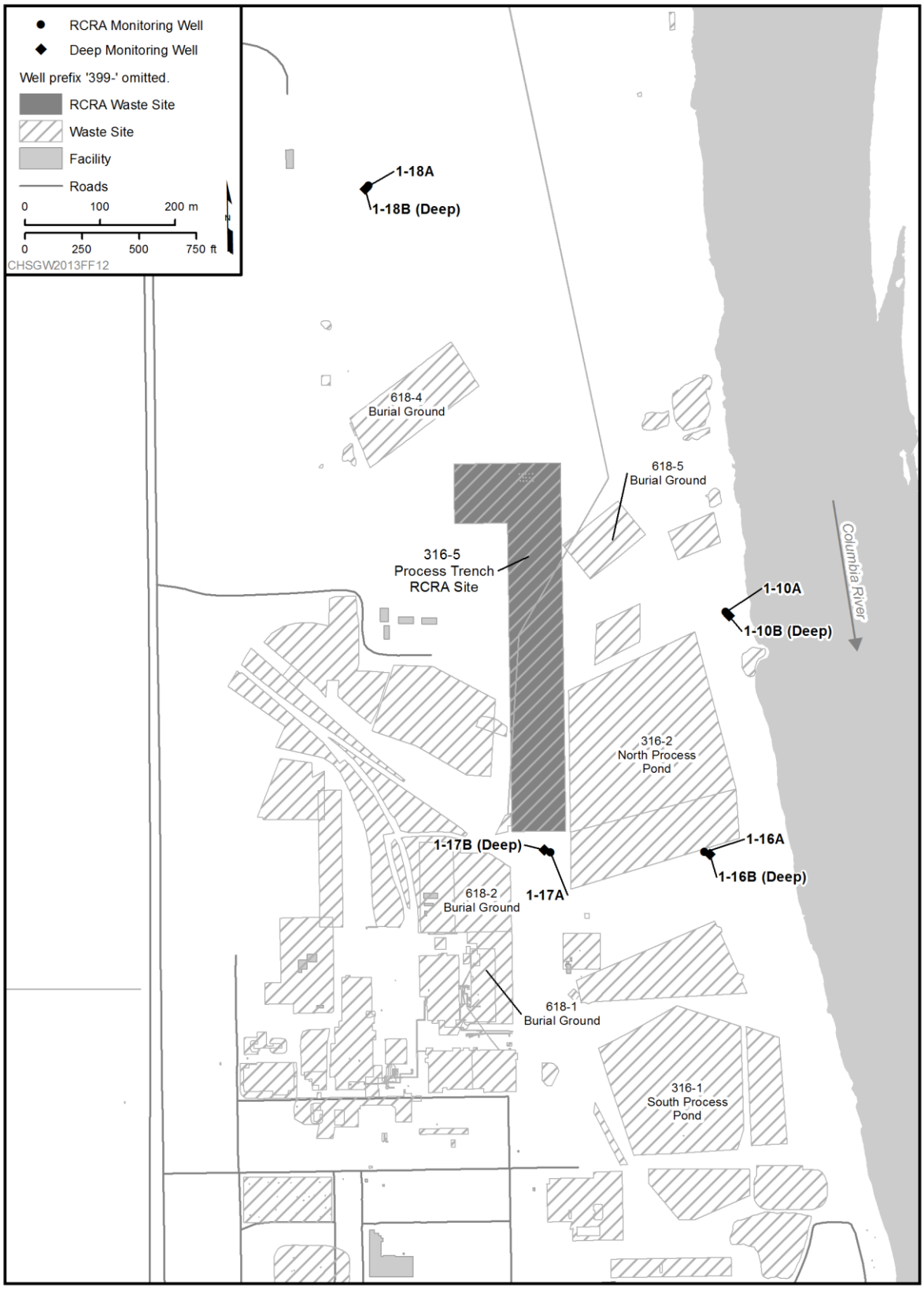

Figure 7-23. 316-5 Process Trenches

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